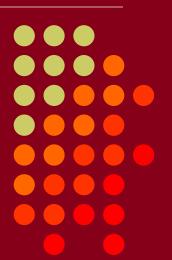
CTU Presents

Optimizing VHF Contest Scores Utilizing JT Digital Modes

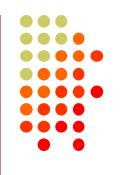
Joel Harrison, W5ZN



• CTU • CONTEST UNIVERSITY



Before We Talk "Digital" Let's Review Some Basic Topics



- Antenna Techniques
- Station Techniques
- Propagation Techniques
- Operating Techniques



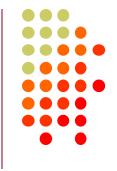


- What Kind of an Antenna?
 - Yagi
 - Horizontal polarization
 - Vertical
 - Dipole / Inverted Vee
- How Many Elements?
 - More is better up to a point.
 - 7 is good
- How High Should it Be?
 - 30 Ft?
 - Let's look at some plots









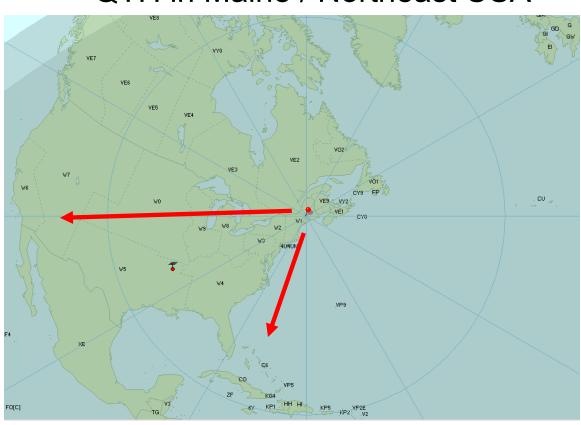
- What is the best height for my antenna?
 - You will always have dead zones and nulls regardless of height
 - Get your antennas as high as you reasonable can
- How Many Antennas do I need?
 - Really depends on where you live







QTH in Maine / Northeast USA

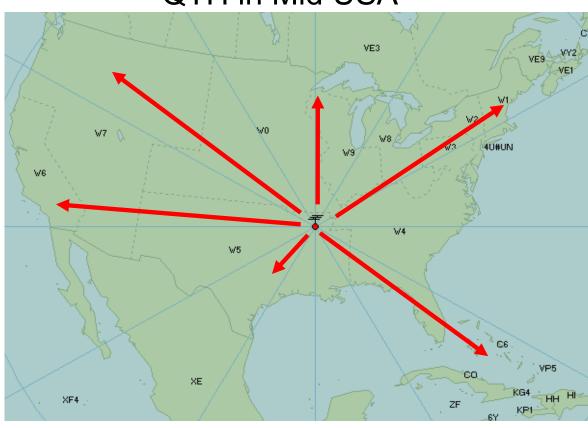








QTH in Mid USA









How can you quickly change antenna direction??

Antenna, or a stack of smaller antennas in a fixed direction allow fast direction change without waiting for a rotor to turn.







- Radio
- Preamp
- Interconnecting cables
- Noise







- Radio
 - All new radios include 6 meters
 - Good dynamic range, roofing filters essential
- Preamp
- Interconnecting cables
- Noise









· CTT







Radio

- All new radios include 6 meters
- Good dynamic range, roofing filters essential

Preamp

 Will improve weak sigs when band is dead but can cause problems in presence of strong stations

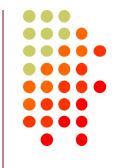
Interconnecting cables

- Ensure solid connections
- Avoid cheap phono connectors & cable

Noise







Noise! The Grim Reaper of noise is *not* your friend!!



- Sky Noise
- Atmospheric Noise
- Line Noise
- Other man-made noise







- Internet Routers can be a significant noise source at 50 MHz that will populate the band, especially the DX Window
 - Multiple carriers of relatively constant amplitude but with modulation (Birdies)
 - 50.044, 50.058, 50.105, 50.120, 50.148, 50.166
 - Broadband trash
- Get your own station "clean" first!







Internet Router noise can be significantly reduced or eliminated.

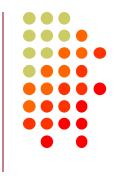




Also utilize shielded CAT5 cable and connectors







Some Actual Results

- All "birdies" are gone
- Noise floor dropped 8 dBm !!!

More technical info:

- A Ham's Guide to RFI, Ferrites, Baluns and Audio Interfacing - Jim Brown, K9YC
 - http://audiosystemsgroup.com





Noise – Recap

- Clean up your own station
- Address line noise issues
- Use Bandpass Filters









Propagation Techniques

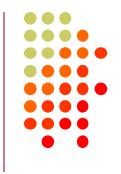


Meteor Scatter – "MS"

Moonbounce - EME



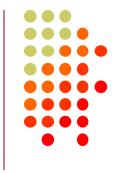




- Meteor scatter is the reflection of radio waves from the ionized trails from meteors burning up in the upper atmosphere.
- Meteors (space debris) burn up in the upper atmosphere at a height of around 65 miles.
- This may be used to make QSOs up to about 1400 miles



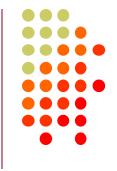




 The earth is bombarded by a constant stream of small particles, remnants of comets that when entering the earth's atmosphere can ionize a column of atoms in the E region at approximately 100km (~60 miles) above the surface of the earth which can reflect radio waves in the VHF region of the spectrum



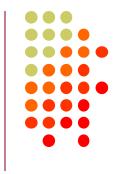




- There are seasonal variations in the number of sporadic meteors
 - Relative rate increases noticeably in May, peaking in July and August then tailing off into October and November.
- There is also an hourly variation in the relative rate of meteors peaking
 - around dawn local time with the minimum late afternoon before the ramp up begins again late evening.
 - The hourly relative rate is due to the fact that the earth's rotation is head on so to speak in the morning into the path of the particles and therefore there is an increase in the relative velocity of a particle entering the earth's atmosphere.







 The length of time of the ionization, or burst duration, is related to meteor velocity and increase in relative velocity results in longer ionization times.



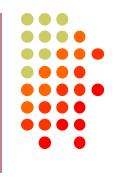




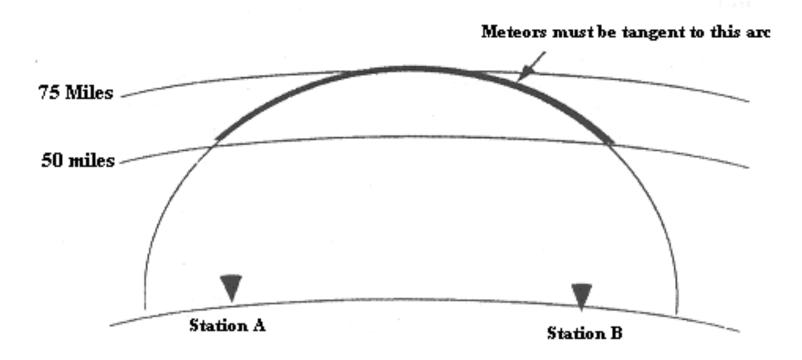
- Most particles entering the earth's atmosphere are the size of a grain of sand resulting in ionization lasting only a fraction of a second
 - much too short to convey any meaningful information using SSB or even high speed CW.
- The digital modes of FSK441 and MSK144 were designed to compress a limited amount of information in a packet and transmit that packet in a very short period of time.
 - In the case of MSK144 the information packet, with a transmission length 0.072 seconds, is repeated over and over again during the duration of the selected transmit interval of 5, 10, 15 or 30 seconds.





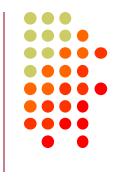


Reflection will occur when the trail is oriented as shown









- Excellent for 50 MHz
- Very Predictable Paths
 - Best times between midnight & approx 9 AM
 - Peak during "showers" Anytime with high speed procedures like <u>WSJT</u>





Operating Techniques



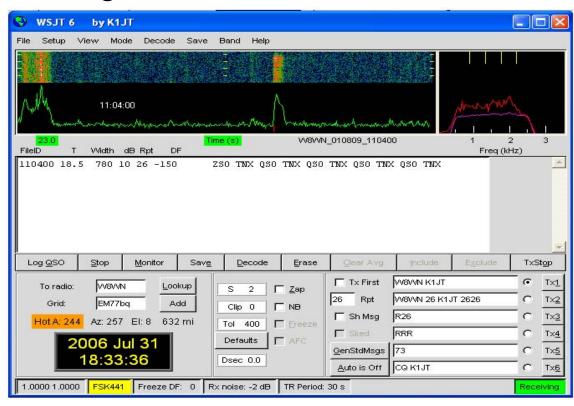
K1JT Digital Modes

- Weak Signal Communication by K1JT (WSJT) offers specific digital protocols optimized for EME and meteor scatter at VHF/UHF
- Free open-source programs. Normal usage requires only a standard SSB transceiver and a personal computer with soundcard.
- Can Provide Outstanding access to new grid multipliers from moderate stations





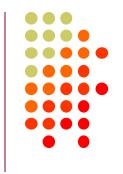
Original JT "FSK441" MS Mode







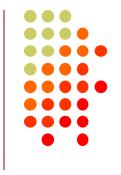




- New Mode introduced in WSJT-X
 - Officially released in January 2017
 - Contains 8 new modes
 - MFSK441 Mode
 - Calling frequencies 50.280
 - Many new features







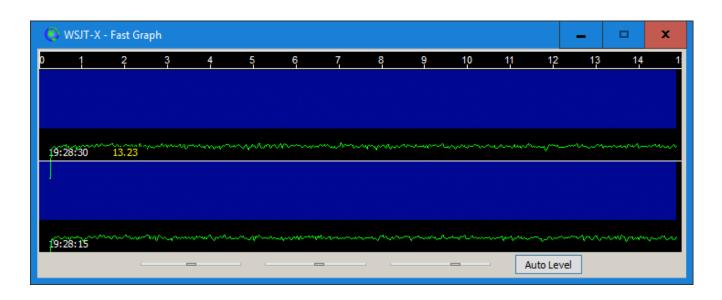
- Focussed toward contest style operation that include:
 - a machine human interface that facilitates rapid population of QSO specific information
 - shorter TX and RX periods than FSK441
 - auto sequencing that reduces human error and improves operator efficiency important considerations during contest operation







Graph still exists but in a separate window called "Fast Graph"

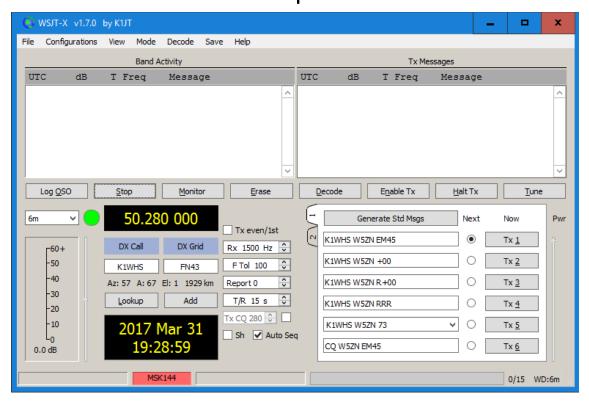








MSK144 Window is different from previous FSK441 Window"

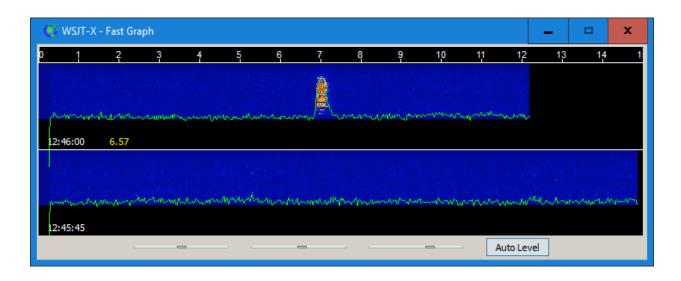








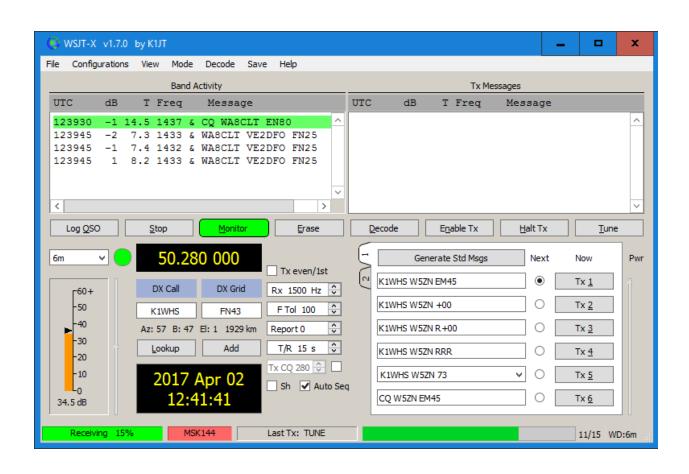
Signal bursts still appear in the "Fast Graph"

















○ WSJT-X v1.7.0 by K1JT		_	□ X				
File Configurations View Mode Decode Sav	re Help						
Band Activity		Tx Messages					
UTC dB T Freq Message		UTC dB T Freq Message					
123930 -1 14.5 1437 & CQ WASCLT VE 123945 -2 7.3 1433 & WASCLT VE 123945 -1 7.4 1432 & WASCLT VE 123945 1 8.2 1433 & WASCLT VE	2DFO FN25 2DFO FN25 2DFO FN25	123930 -1 14.5 1437 & CQ WA8CLT E	~				
	>	<u> </u>	>				
Log QSO Stop Monitor	<u>E</u> rase	Decode Enable Tx Halt Tx	<u>T</u> une				
6m v 50.280 000	Tx even/1st	Generate Std Msgs Next	Now Pwr				
	Rx 1500 Hz 🗘	WASCLT W5ZN EM45	Tx <u>1</u>				
-50 WASCLT EN80	F Tol 100 🗘	WA8CLT W5ZN -01	Tx <u>2</u>				
-40 Az: 49 B: 35 El: 9 895 km	Report -1	WASCLT W5ZN R-01	Tx <u>3</u>				
-30 <u>L</u> ookup Add	T/R 15 s 🗘	WASCLT W5ZN RRR	Tx <u>4</u>				
¹⁰ 2017 Apr 02	Tx CQ 280 🗘 🗌	WA8CLT W5ZN 73	Tx <u>5</u>				
35.4 dB 12:42:09	12:42:09		Tx <u>6</u>				
Receiving 24% MSK144	Last Tx: TUNE		9/15 WD:6m				





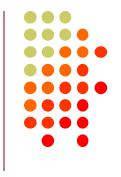


Tx Messages	WSJT-X v1.7.0 by K1JT						_	-	x
UTC dB T Freq Message 123930 -1 14.5 1437 6 CQ WA8CLT EN80		·			Tv	Massages			
123930		•							_
123945	UTC dB T Freq	Message	UTC	dB	T Freq	Messa	ge		
123945	123930 -1 14.5 1437 &	CQ WASCLT ENSO ^			14.5 1437	& CQ WA8	CLT EN	80	^
Log QSO Stop Monitor Erase Decode Enable Tx Halt Tx Tune			124	215 Tx	1500	& WASCL	r W5ZN	EM45	_
Log QSO Stop Monitor Erase Decode Enable TX Tune 6m									
Log QSO Stop Monitor Erase Decode Enable Tx Halt Tx Tune 50.280 000 Tx even/1st WASCLT W5ZN EM45 DX Call DX Grid Rx 1500 Hz → WASCLT W5ZN EM45 WASCLT W5ZN R-01 Az: 49 B: 35 El: 9 895 km Report -1 → Lookup Add T/R 15 s → Lookup Add T/R 15 s → WASCLT W5ZN RRR Tx 1 WASCLT W5ZN RRR Tx 2 WASCLT W5ZN RRR Tx 4 CQ W5ZN EM45 Tx 6	123945 1 8.2 1433 &	WASCLT VE2DFO FN25							
Log QSO Stop Monitor Erase Decode Enable Tx Halt Tx Tune 50.280 000 Tx even/1st DX Call DX Grid Rx 1500 Hz → WASCLT W5ZN EM45 Tx 1 WASCLT W5ZN R45 Tx 2 WASCLT W5ZN R-01 Tx 2 WASCLT W5ZN R-01 Tx 3 Lookup Add T/R 15 s → Lookup Add T/R 15 s → Sh ✓ Auto Seq CQ W5ZN EM45 Tx 6									
Log QSO Stop Monitor Erase Decode Enable Tx Halt Tx Tune 6m ✓ 50.280 000 Tx even/1st ✓ Generate Std Msgs Next Now Pwr 60+ -50- -40- -30- -20- -10- 0 0.0 dB DX Grid Rx 1500 Hz Rx 1500 Hz ✓ WA8CLT W5ZN EM45 ✓ Tx 1/2 WA8CLT W5ZN F.01 Tx 2 WA8CLT W5ZN R-01 Tx 3 WA8CLT W5ZN RRR Tx 4/2 WA8CLT W5ZN RRR Tx 4/2 Tx 5/2 WA8CLT W5ZN 73 ✓ Tx 5/2 WA8CLT W5ZN 73 CQ W5ZN EM45 Tx 6/2 Tx 6/2									
6m	<	>	<u> </u>						>
Tx even/ist DX Call	Log QSO Stop	Monitor Erase		ecode	Enable Tx	Halt 7	x	<u>T</u> une	-
Tx even/1st DX Call			_						
Tx even/ist DX Call	6m v 50.28	30 000	[Ge	nerate Std Msg	s Ne	xt I	Now	Pwr
DX Call DX Grid Rx 1500 Hz		☐ Tx even/1st							
-50 -40 -40 -30 -20 -10 0 0.0 dB WASCLT ENS0 F Tol 100	r60+ DX Call	DX Grid Rx 1500 Hz	(WA8CLT W	5ZN EM45			Tx <u>1</u>	Î
WASCLT ENSO	F0			WA8CLT W	5ZN -01) [Tx 2	
Az: 49 B: 35 E: 9 895 km Report -1 WASCLT W5ZN RRR TX 4 Lookup Add T/R 15 s WASCLT W5ZN RRR Tx CQ 280 S WASCLT W5ZN RRR WASCLT W5ZN RRR WASCLT W5ZN RRR Tx 5 CQ W5ZN EM45 CQ W5ZN EM45	WASCLI							_	
Lookup Add T/R 15 s	Az: 49 B: 35	El: 9 895 km Report -1		WA8CLT W	5ZN R-01) [Tx <u>3</u>	
2017 Apr 02 0.0 dB 2017 Apr 02 12:42:28 □ Sh ✓ Auto Seq □ CQ W5ZN EM45 □ Tx 6 □ Tx 7 □ Tx 6 □ Tx 7 □ Tx 6 □ Tx 7 □ T	Lookup	Add T/R 15 s		WASCIT W	57N RRR) [-	Tv 4	
2017 Apr 02 0.0 dB	-20	Tx CO 280 🖺			2.11001			. A <u></u>	
0.0 dB 12:42:28 CQ W5ZN EM45 Tx 6	2017	Δpr 02		WA8CLT W	5ZN 73	v) [Tx <u>5</u>	
	12.4	☐ Sh ☑ Auto Se	q	CO WEZNIE	MAE			Tv 6	
Tx: WA8CLT W5ZN EM45 MSK144 Last Tx: WA8CLT W5ZN EM45 13/15 WD:6m	0.0 dB	12.20		CQ WOZINE	UTJ			1 X Q	
Tx: WA8CLT W5ZN EM45 MSK144 Last Tx: WA8CLT W5ZN EM45 13/15 WD:6m	, i								
15/15 WEIGHT	Tx: WA8CLT W5ZN EM45 MSF	Last Tx: WA8CLT W5ZN EN	145					13/15 W	/D:6m





K8ZR Test Results



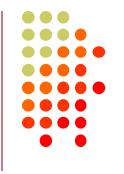
- Contest QSO Non-Contest QSO
- Tx Time:
- 15 sec. CQ N8JX EN64
- 15 sec. N8JX K8ZR EN91
- 15 sec. K8ZR N8JX R EN64
- 15 sec. N8JX K8ZR RRR
- 15 sec. K8ZR N8JX 73
- Total time: 75 seconds

- Non-Contest QSO
- Tx Time:
- 15 sec. CQ WB4JWM EM83
- 15 sec. WB4JWM K8ZR EN91
- 15 sec. K8ZR WB4JWM +05
- 15 sec. WB4JWM K8ZR R+07
- 15 sec. K8ZR WB4JWM RRR
- 15 sec. WB4JWM K8ZR 73
- Total time: 90 seconds





K8ZR Test Results



50 MHz MSK144 QSO Summary

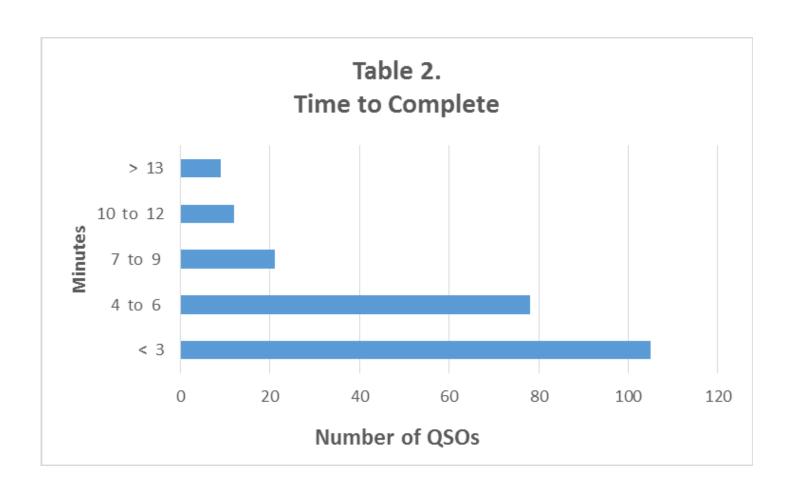
•	Period January 23rd- March 13th:	50 days
	Number of 50 MHz MSK144 QSOs:	225
	Average number of minutes to complete a QSO:	4.6
	Number of unique callsigns worked:	50
	Number of unique callsigns decoded:	98
	Number of States worked:	22
	Number of unique Grids worked:	42
	Number of 90 second QSOs:	10
	Best DX K5DOG EM00wh:	1.223 miles





K8ZR Test Results

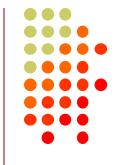








Important Techniques



- The Same Principles for HF Apply to VHF
 - Tower & Electrical Safety
 - Station Ergonomics
 - Physical Fitness
 - ETHICS !!!
 - A system of moral values and motivation based on right and wrong
 - "The rules are black and white, we make them gray!" K5ZD, CTU Dayton 2009





Where to Learn More

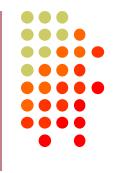


- VHF Conferences & Microwave Update
 - Central States VHF Society (CSVHFS)
 - Northeast Weak Signal Society (NEWS)
 - Southeast VHF Society (SEVHFS)
 - Western States Weak Signal Society (WSWSS)
 - Microwave Update Conference
 - Not "traditional" hamfests
 - Publish proceedings (compilation of technical papers)





Acknowledgement



 Thanks to Tony, K8ZR (x-WA8RJF) for supplying additional information on Meteor Scatter



